Electromagnetic Methods to Delineate Areas of High Conductivity in Shallow Aquifers, East Poplar Oil Field Area, Northeastern Montana, 2004

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Areas of high electromagnetic (EM) conductivity in shallow aquifers in the East Poplar oil field area are being delineated by the U.S. Geological Survey (USGS), in cooperation with the Fort Peck Assiniboine and Sioux Tribes, in order to determine probable areas of saline-water contamination. An airborne EM survey was conducted during August 2004 in a 106-square-mile area that includes the East Poplar oil field on the Fort Peck Indian Reservation. The EM equipment consisted of six different coil-pair orientations that measured resistivity at separate frequencies from about 400 Hertz (Hz) to more than 100,000 Hz. The EM resistivity data were converted to six conductivity grids, each representing different approximate depths. The conductivity grids (at depths similar to the shallow aquifers) were used to delineate areas of high EM conductivity. Boreholes in the area were logged with electrical conductivity probes to aid in calibration and electrical characterization of lithology and ground water. Water-quality samples were collected from selected wells during September 2004 to correlate geophysical measurements with the chemical composition of water from shallow aquifers.

Ground EM methods were previously used by the USGS during the early 1990s to delineate more than 12 square miles of saline-water contamination in a portion of the East Poplar oil field area. Those efforts determined that saline water had affected not only the shallow aquifers, but also the Poplar River. In the 10 years since the first delineation, the quality of water from some wells completed in the shallow aquifers in the East Poplar oil field area has changed markedly. The current (2004) extent of saline-water plumes likely differs from that delineated in the early 1990s. The City of Poplar, which relies solely on the shallow aquifers for water, is less than 3 miles downgradient from a saline water plume that was delineated in the early 1990s. A current delineation of high EM conductivity in the shallow aquifers will aid in understanding possible plume migration.